//Program-4

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//This program accepts a square matrix and outputs the matrix after gaussian elimination. Finally, prints the determinant of the inputted matrix.

#include<iostream>

#include<vector>

#include <math.h>//exp

#include<iomanip>//precission

#include<fstream>

#include<algorithm>

using namespace std;

ofstream out;

long double d;

//Matrix input

vector<vector<long double>> getIniMatrix() {

int N;

cout << "Enter the size of square matrix A :\t";

cin >> N;

vector<vector<long double>> A(N, vector<long double>(N));

cout << "Enter the co-efficients of matrix A :\n";

for (int i = 0; i<N; i++) {

for (int j = 0; j<N; j++) {

cout << " A[" << i << "][" << j << "] = ";

cin >> A[i][j];

cout << endl;

}

}

return A;

}

//prints matrix to file

void printMatrix(vector< vector<long double> > A) {

int n = A.size();

for (int i = 0; i<n; i++) {

for (int j = 0; j<n; j++) {

out << A[i][j] << "\t";

}

out << "\n";

}

out << endl;

}

//gaussian elimination algorithm

vector<vector<long double>> gauss(vector< vector< long double> > A) {

int n = A.size();

for (int i = 0; i<n; i++) {

// Search for maximum in this column

double maxEl = abs(A[i][i]);

int maxRow = i;

for (int k = i + 1; k<n; k++) {

if (abs(A[k][i]) > maxEl) {

maxEl = abs(A[k][i]);

maxRow = k;

}

}

// Swap maximum row with current row (column by column)

for (int k = i; k<n; k++) {

double tmp = A[maxRow][k];

A[maxRow][k] = A[i][k];

A[i][k] = tmp;

}

// Make all rows below this one 0 in current column

for (int k = i + 1; k<n; k++) {

double c = -A[k][i] / A[i][i];

for (int j = i; j<n; j++) {

if (i == j) {

A[k][j] = 0;

}

else {

A[k][j] += c \* A[i][j];

}

}

}

}

return A;

}

long double det(int n, vector<vector<long double>> mat)

{

int c, subi, i, j, subj;

vector<vector<long double>> submat(n, vector<long double>(n));

//if the Matrix is 1X1

if (n == 1)

return mat[0][0];

//if the Matrix is 2X2

if (n == 2)

{

return((mat[0][0] \* mat[1][1]) - (mat[1][0] \* mat[0][1]));

}

else

{

//for NXN matrix where N >2

for (c = 0; c < n; c++)

{

subi = 0;

for (i = 1; i < n; i++)

{

subj = 0;

for (j = 0; j < n; j++)

{

if (j == c)

{

continue;

}

submat[subi][subj] = mat[i][j];

subj++;

}

subi++;

}//cross multiply

d = d + (pow(-1, c) \* mat[0][c] \* det(n - 1, submat));

}

}

return d;

}

//printing the content to file

void printToFile() {

out << "Divyashree H B\n" << endl;

out << "Gaussian Elimination and Determinant of the matrix\n" << endl;

out << "5/1/2017\n" << endl;

vector<vector<long double>> Amat, A;

A = getIniMatrix();

Amat = A;

out << "The co-efficients of matrix A is : \n";

printMatrix(Amat);

Amat = gauss(A);

out << endl;

out << "Matrix A after Gaussian Elimination :\n";

printMatrix(Amat);

out << endl;

out << "The determinant of matrix A is " << std::setprecision(6) << det(A.size(), A) << endl;

}

int main() {

std::cout << std::fixed;

std::cout << std::setprecision(9);

out.open("output.txt");

printToFile();

system("pause");

cout << endl;

}